

## PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-123532

(43)Date of publication of application : 25.04.2003

(51)Int.Cl. H01B 1/12  
 B05D 5/12  
 C08J 7/04  
 C09D 5/24  
 C09D201/00  
 C09J 9/02  
 C09J201/00  
 H01B 1/20  
 H01B 5/14  
 H01B 13/00  
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(21)Application number : 2001-316936

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(22)Date of filing : 15.10.2001

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## (54) CONDUCTIVE COMPOSITION, CONDUCTOR AND ITS FORMING METHOD

## (57)Abstract:

PROBLEM TO BE SOLVED: To provide a conductive composition manifesting high conductivity without humidity dependency and having excellent film formability, moldability, achromatic transparency, solvent resistance, water resistance, hardness and weather resistance, and to provide a conductor and a forming method of the conductor obtained by forming a conductive film manifesting high conductivity without humidity dependency and having little dispersion of surface resistance and excellent film formability, moldability, achromatic transparency, solvent resistance, water resistance, hardness and weather resistance.

SOLUTION: This conductive composition comprises an indore derivative trimer A, a solvent B and a cross-linking agent C, and further if necessary, colloidal silica E, a basic compound F, a high molecular compound G, a surfactant H and/or inorganic salt I. The conductor formed of the conductive composition, and its forming method are provided.

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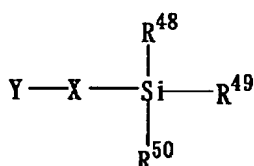
## CLAIMS

[Claim(s)]

[Claim 1] A conductive composition containing an indole-derivatives trimer (A), a solvent (B), and a cross linking agent (C).

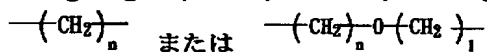
[Claim 2] A silane coupling agent (D) a cross linking agent (C) is indicated to be by a general formula (1),

[Formula 1]



(1)

(R<sup>48</sup>, R<sup>49</sup>, and R<sup>50</sup> are the bases respectively chosen from the group which consists of the straight chain of hydrogen and the carbon numbers 1-6, the alkyl group of branching and the straight chain of the carbon numbers 1-6 or the alkoxy group of branching, an amino group, an acetyl group, a phenyl group, and a halogen group independently among the above-mentioned formula.) X[Formula 2]



An example, and n and l are the numbers to 1-6. Y is the basis chosen from the group which consists of a hydroxyl group, a thiol group, an amino group, an epoxy group, and an epoxycyclohexyl group. The existing conductive composition according to claim 1.

[Claim 3] The conductive composition according to claim 1 or 2, wherein a conductive composition contains colloidal silica (E).

[Claim 4] A conductive composition given in any 1 paragraph of claims 1-3 whose particle diameter of colloidal silica (E) is 1 nm - 300 nm.

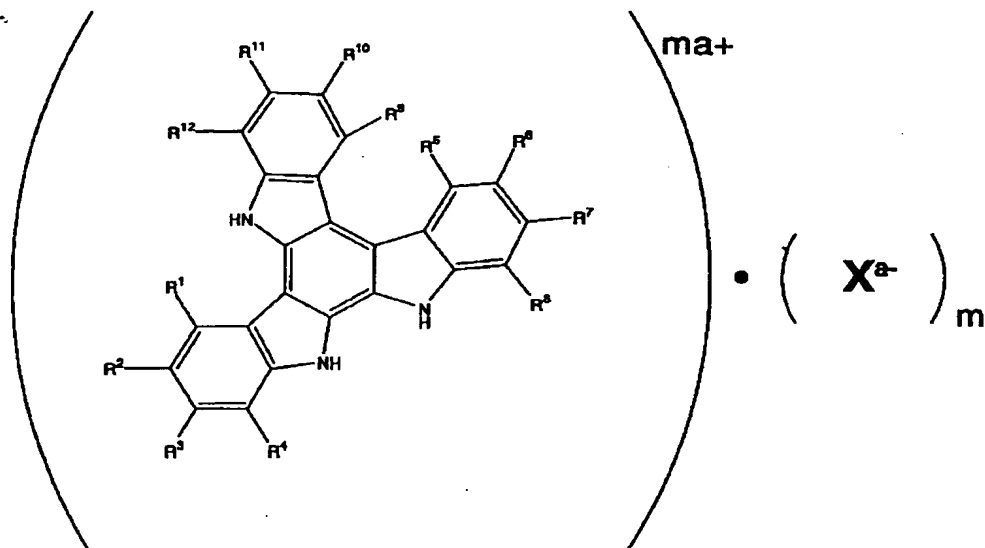
[Claim 5] A conductive composition given in any 1 paragraph of claims 1-4, wherein a conductive composition contains a basic compound (F).

[Claim 6] A conductive composition given in any 1 paragraph of claims 1-5, wherein a conductive composition contains a high molecular compound (G).

[Claim 7] A conductive composition given in any 1 paragraph of claims 1-6, wherein a conductive composition contains a surface-active agent (H).

[Claim 8] A conductive composition given in any 1 paragraph of claims 1-7, wherein a conductive composition contains mineral salt (I).

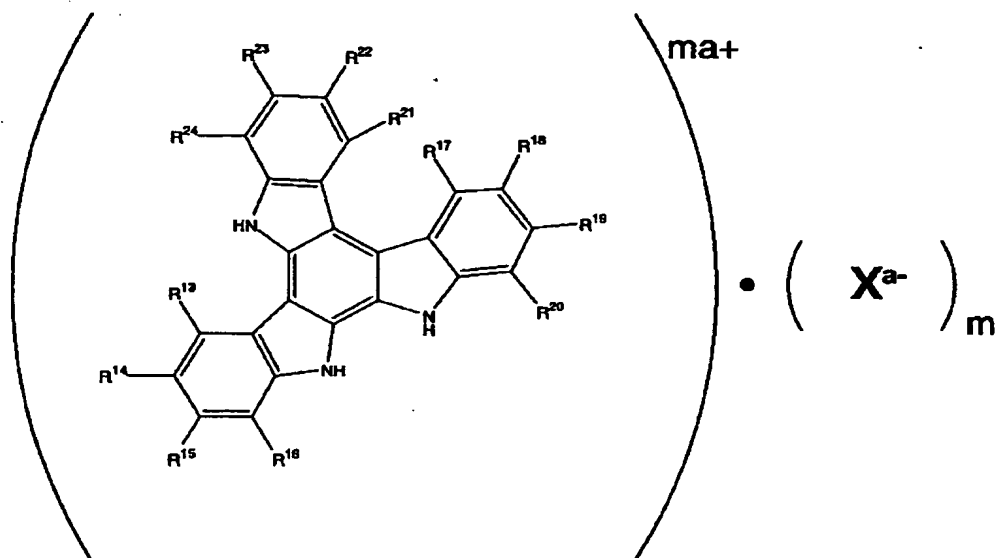
[Claim 9] An indole-derivatives trimer (A), [Formula 3]



(2)

the inside of the above-mentioned formula,  $R^1 - R^{12}$  — the straight chain of hydrogen and the carbon numbers 1–24, or the alkyl group of branching. The straight chain of the carbon numbers 1–24, the alkoxy group of branching and the straight chain of the carbon numbers 2–24, or the acyl group of branching, The straight chain of an aldehyde group, a carboxylic acid group, and the carbon numbers 2–24, or the carboxylate group of branching, It is the substituent independently chosen from the group which consists of the straight chain of a sulfonic group and the carbon numbers 1–24 or the sulfonic ester group of branching, a cyano group, a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively.  $X^{a-}$  A chloride ion, a bromine ion, iodine ion, A fluorine ion, nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, Way fluoridation ion, a perchlorate ion, thiocyanic acid ion, acetate ion, Propionic acid ion, methanesulfonic acid ion, p-toluenesulfonic-acid ion, They are at least one sort of negative ion chosen from 1 which consists of trifluoro acetate ion and trifluoromethanesulfonic acid ion – a trivalent negative ion group, a expresses the ionic valence of X, it is an integer of 1–3, m is a dope rate, and the value is 0–0.5. Conductive composition given in any 1 paragraph of some claims 1–8.

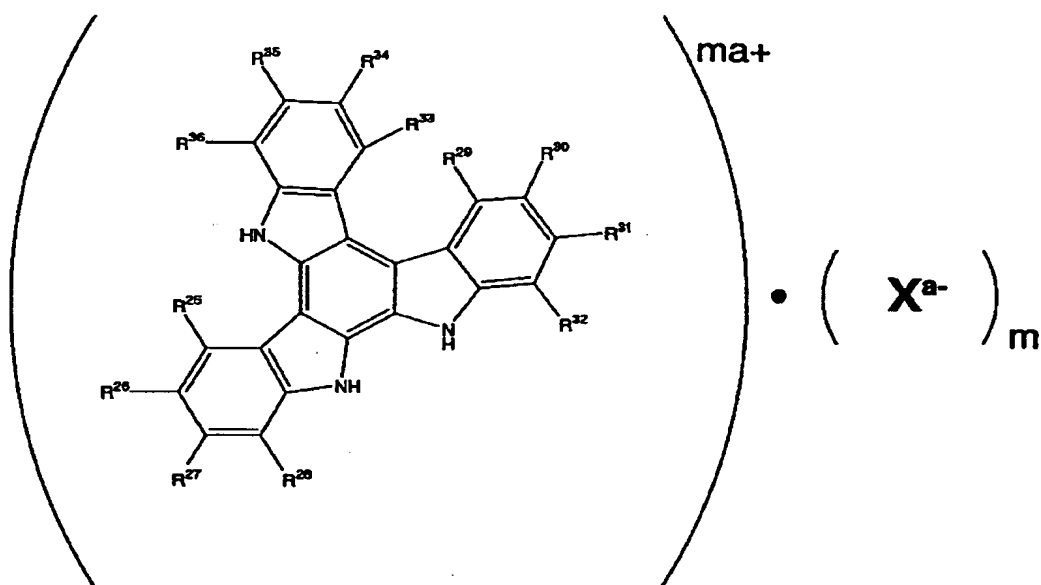
[Claim 10]An indole-derivatives trimer (A),[Formula 4]



(3)

$R^{13} - R^{24}$  among the above-mentioned formula The straight chain of hydrogen and the carbon numbers 1-24, or the alkyl group of branching. The straight chain of the carbon numbers 1-24, the alkoxy group of branching and the straight chain of the carbon numbers 2-24, or the acyl group of branching. The straight chain of an aldehyde group, a carboxyl group, and the carbon numbers 2-24, or the carboxylate group of branching. The straight chain of a sulfonic group and the carbon numbers 1-24, or the sulfonic ester group of branching. It is shown by the substituent independently chosen from the group which consists of a cyano group, a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively, and at least one of  $R^{13} - R^{24}$  is the basis chosen from the cyano group, the nitro group, the amide group, or the halogen group.  $X^{a-}$  A chloride ion, a bromine ion, iodine ion, a fluorine ion, Nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, way fluoridation ion, A perchlorate ion, thiocyanic acid ion, acetate ion, propionic acid ion, Methanesulfonic acid ion, p-toluenesulfonic-acid ion, trifluoro acetate ion, And it is at least a kind of negative ion chosen from 1 which consists of trifluoromethanesulfonic acid ion - a trivalent negative ion group, a expresses the ionic valence of X, it is an integer of 1-3, m is a dope rate, and the value is 0-0.5. Conductive composition given in any 1 paragraph of some claims 1-9.

[Claim 11]An indole-derivatives trimer (A), [Formula 5]

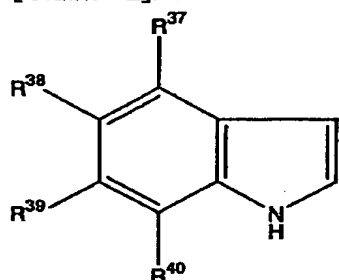


(4)

the inside of the above-mentioned formula,  $R^{25} - R^{36}$  — the straight chain of hydrogen and the carbon numbers 1-24, or the alkyl group of branching. The straight chain of the carbon numbers 1-24, the alkoxy group of branching and the straight chain of the carbon numbers 2-24, or the acyl group of branching. The straight chain of an aldehyde group, a carboxyl group, and the carbon numbers 2-24, or the carboxylate group of branching. The straight chain of a sulfonic group and the carbon numbers 1-24, or the sulfonic ester group of branching. It is shown by the substituent independently chosen from the group which consists of a cyano group, a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively, and at least one of  $R^{25} - R^{36}$  is a sulfonic group or a carboxyl group.  $X^{a-}$  A chloride ion, a bromine ion, iodine ion, a fluorine ion, Nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, way fluoridation ion, A perchlorate ion, thiocyanic acid ion, acetate ion, propionic acid ion,

Methanesulfonic acid ion, p-toluenesulfonic-acid ion, trifluoro acetate ion, And it is at least a kind of negative ion chosen from 1 which consists of trifluoromethanesulfonic acid ion – a trivalent negative ion group, a expresses the ionic valence of X, it is an integer of 1–3, m is a dope rate, and the value is 0–0.5. Conductive composition given in any 1 paragraph of some claims 1–10.

[Claim 12]An indole-derivatives trimer (A). [Formula 6]



(5)

( $R^{37} - R^{40}$  among the above-mentioned formula) The straight chain of hydrogen and the carbon numbers 1–24, the alkyl group of branching and the straight chain of the carbon numbers 1–24, or the alkoxy group of branching, The straight chain of the carbon numbers 2–24 or the acyl group of branching, an aldehyde group, a carboxyl group, The straight chain of the carbon numbers 2–24 or the carboxylate group of branching, a sulfonic group, The straight chain of the carbon numbers 1–24 or the sulfonic ester group of branching, a cyano group, It is the substituent independently chosen from the group which consists of a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively. At least a kind of indole derivatives shown, A conductive composition given in any 1 paragraph of claims 1–11 characterized by being the indole-derivatives trimer obtained by making it react with a kind of oxidizer into the reaction mixture containing at least a kind of solvent at least.

[Claim 13]A conductive composition given in any 1 paragraph of claims 1–12, wherein an indole-derivatives trimer (A) is a laminated structure.

[Claim 14]A conductor having a transparent conductive film formed in any 1 paragraph of claims 1–13 from a conductive composition of a statement.

[Claim 15]The conductor according to claim 14, wherein acid has added to a transparent conductive film as a dopant.

[Claim 16]A transparent conductive film is temperature. 25 \*\*, relative humidity A conductor given in claim 14 or the 15th paragraph, wherein surface resistance values in 15% are  $10^5 - 10^{12}$  ohm.

[Claim 17]A transparent conductive film is temperature. A conductor given in any 1 paragraph of claims 14–16, wherein a rate of change (SR1 (surface resistance value after being immersed into 40 \*\* solvent for 1 hour)/SR0 (surface resistance value before immersion)) of a surface resistance value after being immersed into a 40 \*\* solvent for 1 hour is less than ten.

[Claim 18]A formation method of a conductor characterized by performing neglect or heat-treatment at ordinary temperature after applying a conductive composition of a statement to any 1 paragraph of claims 1–13 and forming a transparent conductive film on at least one field of a substrate.

[Claim 19]A formation method of the conductor according to claim 18 performing doping processing by acid and performing neglect or heat-treatment at ordinary temperature subsequently after forming a transparent conductive film.

[Claim 20]A formation method of the conductor according to claim 18 or 19 heat-treating from ordinary temperature in a 250 °C temperature requirement.

## DETAILED DESCRIPTION

### [Detailed Description of the Invention]

#### [0001]

[Field of the Invention]This invention relates to a conductor formed from the conductive composition containing an indole-derivatives trimer, and this conductive composition, and a formation method for the same. The conductive composition of this invention by using simple techniques, such as spreading, a spray, the cast, and dip, various sprays for preventing static electricity, It is applicable to uses, such as a capacitor, a cell, EMI shielding, a chemical sensor, a display device, nonlinear material, an anticorrosive, adhesives, textiles, an antistatic coating, an anticorrosive paint, an electrodeposition paint, a plating primer, an electrically conductive primer for electrostatic coating, electric anticorrosion, and accumulation-of-electricity ability improvement of a cell. The conductor of this invention Industrial use wrapping, such as a semiconductor and electrical machinery electronic parts, Antistatic films, such as electro photography recording materials, such as a film for overhead projectors, and a slide film, The prevention from electrification of tapes for magnetic recording, such as an audiotape, videotape, a tape for computers, and a floppy disk, The input of a transparent touch panel, an electroluminescence display, a liquid crystal display, etc., and the prevention from electrification and the transparent electrode on the surface of a display device, It is used as the luminescent material which forms an organic electroluminescence element, buffer material, an electron transport material, a hole transporting material, and a fluorescent material.

#### [0002]

[Description of the Prior Art]Conventionally, as an electric conduction ingredient of a conductive composition, conductive polymers, such as organic system conducting agents, such as inorganic system conducting agents, such as metal system powder, carbon powder, and ITO, and a surface-active agent, and poly aniline, and sulfonation poly aniline, are known.

[0003]although the conducting film formed from the conductive composition which consists of carbon powder, metal powder, and a high molecular compound in these is excellent in the endurance of a coat — the addition of an electric conduction ingredient — ten mass part — about 30 mass parts are needed and there is a fault that transparency is missing. In order to make transparency reveal, when the addition of an electric conduction ingredient is reduced, sufficient conducting performance has a fault which is not acquired. What gave hydrophilic nature and ionicity and gave conductivity to the film surface is known by scouring a surface-active agent with translucent anionic system, cation system, non-ion system, both sexes, etc., etc. in a plastic film, or on the other hand, coating the plastic film surface with them. However, for ion conductivity, that conductivity tends to be influenced by the humidity in the atmosphere, and the conducting film obtained by this method has the fault that the surface resistance value per unit area cannot obtain conductivity below  $10^9 \Omega$  stably on condition of low humidity.

[0004]It is known that the conductor produced by vapor-depositing ITO (indium tin oxidation thing) as an

electric conduction ingredient is excellent in transparency and conductivity. However, since a vacuum evaporator is necessary in order to make the thin film form, creation of a conducting film is complicated, and the device is expensive. And since ITO used as a material is also expensive, the conductor obtained also has the fault of becoming expensive.

[0005] Although the conductive polymer which doped poly aniline etc. is known well, there is a fault that it is insoluble to almost all solvents, and shaping and processing are difficult. Although the method (JP,60-235831,A, J.Polymer Sci., Polymer Chem.Ed., and [26, 1531] (1988)) of carrying out electrolytic oxidation polymerization of the aniline can form the film of poly aniline on an electrode, There is a fault that isolation operation's becoming complicated and extensive composition are difficult. Although the conductive composition (JP,3-285983,A) in which poly aniline and acid dissociation constant electric dissociation exponent of a dedope state acquired by the chemical oxidation polymerization of aniline consist of ammonium salt of the proton acid which is 4.8 or less on the other hand is reported, It is hard to say that poly aniline of a dedope state has a fault, such as affecting it, in a coating substrate, and is suitable for it as a general-purpose varnish since it is meltable only to the very strong special solvent of solvent power, such as N-methyl-2-pyrrolidone. The coat obtained from this constituent has coloring of green peculiar to a conductive polymer – blue.

Since the color tone of a substrate and the color tone of the coating material of glazing are affected, the technical problem of an application use being restricted occurs.

[0006] In order to solve the technical problem to the solubility of a conductive polymer, the conductive composition using the conductive polymer (sulfonation poly aniline) which has acidic groups, such as a sulfonic group, in poly aniline is proposed (the patent No. 03051308 gazette, JP,8-143662,A). It is usable in water as a solvent, this constituent does not have humidity dependency, high conductivity is revealed, and forming the conductor excellent in membrane formation nature, a moldability, and transparency is reported. However, since it is colored yellow and the color tone of a substrate and the color tone of the coating material of glazing are affected by sulfonation poly aniline also about the color tone of the coat obtained from this constituent, the technical problem of an application use being restricted occurs.

[0007] On the other hand, the method of compounding the Indore trimer which is not replaced [ which has conductivity by an electrolysis reaction by using Indore as a raw material ] is reported by [Synthetic Metals and 80 (1996) 309 page]. However, in this report, there is no example used as a conductive composition which made the non-substituted indole trimer only form on an electrode, and dissolved in the solvent, and since it is an electrode reaction, it also has the fault that the shape and construction material of a substrate will be limited.

[0008] The indole- 5-carbonitrile which is indole derivatives, Although forming an indole-derivatives trimer on an electrode by the method [Phys.Chem.Chem.Phys., 2, 1241-1248 (2000)] of carrying out electrolytic oxidation polymerization of the indole- 5-carboxylic acid into acetonitrile is reported, Since this is also an electrolysis reaction, it has the fault that the shape and construction material of a substrate will be limited.

[0009]

[Problem(s) to be Solved by the Invention] It is made in order that this invention may solve the problem of everything of the above-mentioned conventional technology, There is no humidity dependency, and it is revealed, and high conductivity Membrane formation nature, a moldability, water-white nature, There is no

humidity dependency using the conductive composition excellent in solvent resistance, a water resisting property, hardness, and weatherability, and this constituent, and high conductivity is revealed, Dispersion in surface resistance is small and it is in providing a conductor produced by making form the conductive film excellent in membrane formation nature, a moldability, water-white nature, solvent resistance, a water resisting property, hardness, and weatherability, and a formation method for the same.

[0010]

[Means for Solving the Problem] In order to solve these technical problems, as a result of inquiring wholeheartedly, this invention persons found out that a constituent containing a trimer and a cross linking agent of indole derivatives fitted this purpose, and reached this invention. That is, the 1st of this invention is a conductive composition containing an indole-derivatives trimer (A), a solvent (B), and a cross linking agent (C). This conductive composition can aim at improvement in performance by colloidal silica (D), a basic compound (F), a high molecular compound (G), a surface-active agent (H), and/or mineral salt (I) being included further. A water resisting property improves by a time of a cross linking agent (C) being a silane coupling agent (D), and high performance is shown that an indole-derivatives trimer is a layer system.

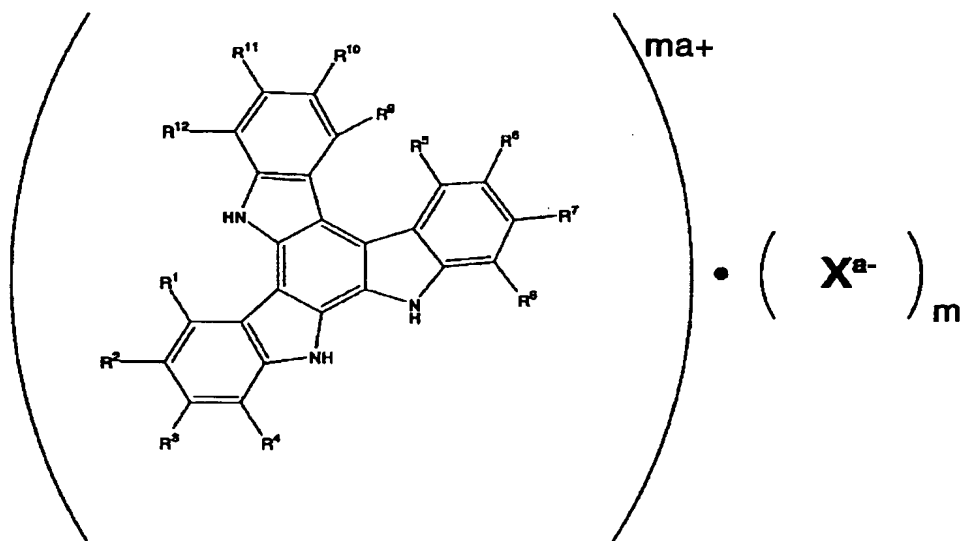
[0011] The 2nd of this invention is a conductor having a transparent conductive film formed from this conductive composition. Improvement in performance can be further aimed at because acid has added to this transparency conductive film as a dopant.

[0012] It is a formation method of a conductor performing neglect or heat-treatment at ordinary temperature after applying this conductive composition and forming a transparent conductive film on at least one field of the 3rd substrate of this invention.

[0013]

[Embodiment of the Invention] Hereafter, the conductor formed from the conductive composition and this conductive composition of this invention and its formation method are explained in detail.

[0014] As the indole-derivatives trimer (A) which constitutes the conductive composition and conductor of this invention, [Formula 7]



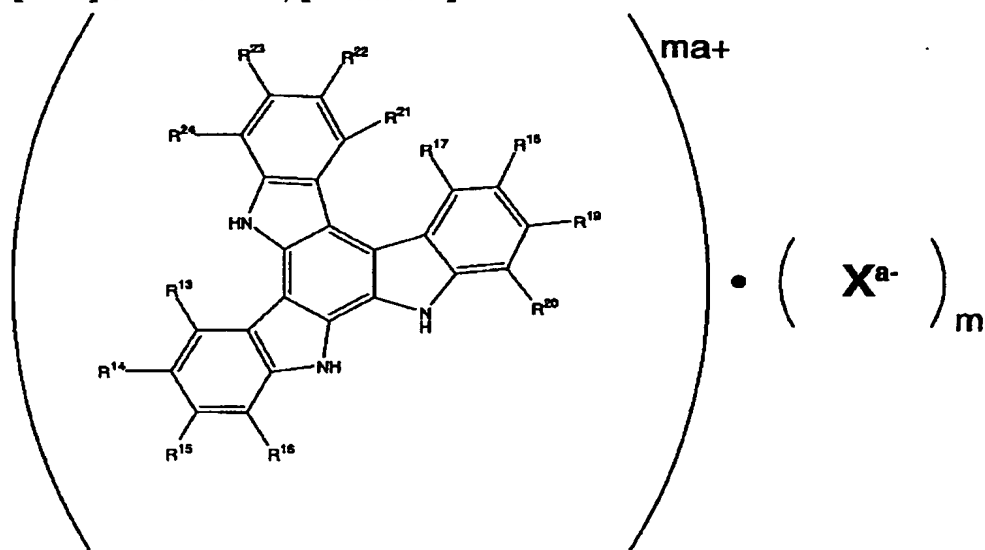
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the inside of the above-mentioned formula,  $R^1 - R^{12}$  — the straight chain of hydrogen and the carbon numbers 1–24, or the alkyl group of branching. The straight chain of the carbon numbers 1–24, the alkoxy



group of branching and the straight chain of the carbon numbers 2–24, or the acyl group of branching, The straight chain of an aldehyde group, a carboxyl group, and the carbon numbers 2–24, or the carboxylate group of branching, It is the substituent independently chosen from the group which consists of the straight chain of a sulfonic group and the carbon numbers 1–24 or the sulfonic ester group of branching, a cyano group, a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively.  $X^{a-}$  A chloride ion, a bromine ion, iodine ion, A fluorine ion, nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, Way fluoridation ion, a perchlorate ion, thiocyanic acid ion, acetate ion, Propionic acid ion, methanesulfonic acid ion, p-toluenesulfonic-acid ion, It is at least a kind of negative ion chosen from 1 which consists of trifluoro acetate ion and trifluoromethanesulfonic acid ion – a trivalent negative ion group, and a expresses the ionic valence of X, it is an integer of 1–3, m is a dope rate, and the value is 0–0.5. It is illustrated.

[0015] It is desirable, [Formula 8]

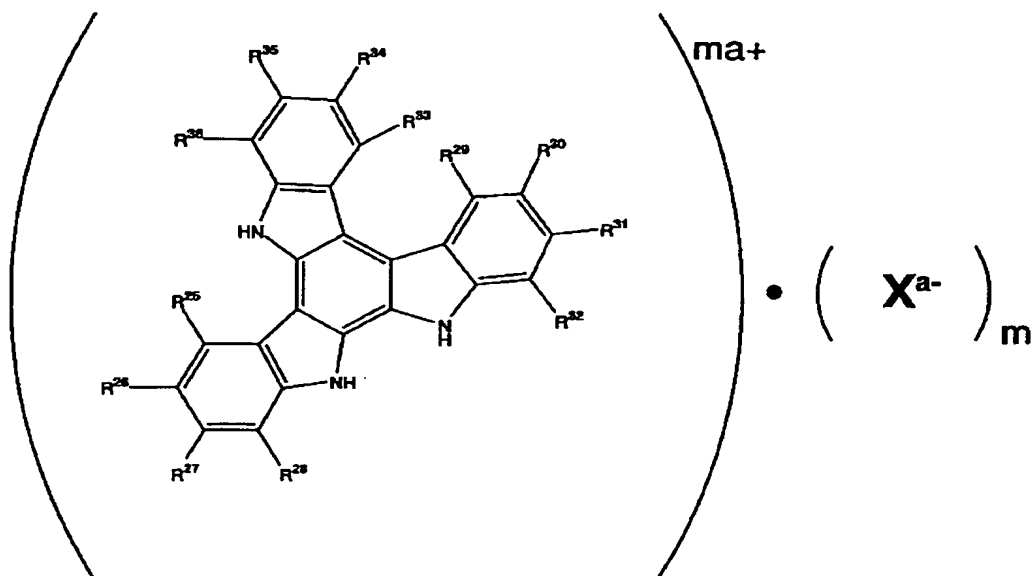


(3)

the inside of the above-mentioned formula,  $R^{13} - R^{24}$  — the straight chain of hydrogen and the carbon numbers 1–24, or the alkyl group of branching. The straight chain of the carbon numbers 1–24, the alkoxy group of branching and the straight chain of the carbon numbers 2–24, or the acyl group of branching, The straight chain of an aldehyde group, a carboxyl group, and the carbon numbers 2–24, or the carboxylate group of branching, The straight chain of a sulfonic group and the carbon numbers 1–24, or the sulfonic ester group of branching, It is shown by the substituent independently chosen from the group which consists of a cyano group, a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively, and at least one of  $R^{13} - R^{24}$  is the basis chosen from the cyano group, the nitro group, the amide group, or the halogen group.  $X^{a-}$  A chloride ion, a bromine ion, iodine ion, a fluorine ion, Nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, way fluoridation ion, A perchlorate ion, thiocyanic acid ion, acetate ion, propionic acid ion, Methanesulfonic acid ion, p-toluenesulfonic-acid ion, trifluoro acetate ion, and it is at least a kind of negative ion chosen from 1 which consists of trifluoromethanesulfonic acid ion – a trivalent negative ion group, and a expresses the ionic valence of X, it is an integer of 1–3, m is a dope rate, and the value is 0–0.5. the indole-derivatives trimer shown — and

[0016]

[Formula 9]



(4)

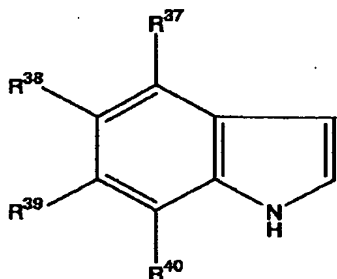
the inside of the above-mentioned formula,  $R^{25} - R^{36}$  — the straight chain of hydrogen and the carbon numbers 1–24, or the alkyl group of branching. The straight chain of the carbon numbers 1–24, the alkoxy group of branching and the straight chain of the carbon numbers 2–24, or the acyl group of branching, The straight chain of an aldehyde group, a carboxyl group, and the carbon numbers 2–24, or the carboxylate group of branching, The straight chain of a sulfonic group and the carbon numbers 1–24, or the sulfonic ester group of branching, It is shown by the substituent independently chosen from the group which consists of a cyano group, a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively, and at least one of  $R^{25} - R^{36}$  is a sulfonic group or a carboxyl group.  $X^{a-}$  A chloride ion, a bromine ion, iodine ion, a fluorine ion, Nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, way fluoridation ion, A perchlorate ion, thiocyanic acid ion, acetate ion, propionic acid ion, Methanesulfonic acid ion, p-toluenesulfonic-acid ion, trifluoro acetate ion, And it is at least a kind of negative ion chosen from 1 which consists of trifluoromethanesulfonic acid ion – a trivalent negative ion group, a expresses the ionic valence of X, it is an integer of 1–3, m is a dope rate, and the value is 0–0.5. The indole-derivatives trimer etc. which are shown are mentioned.

[0017]The carboxyl group substituted indole trimers among these indole-derivatives trimers. Sulfonic group substituted indole trimers and cyano group substituted indole trimers. Nitro group substituted indole trimers and amide group substituted indole trimers. A trimer in which halogen group substituted indole trimers are preferred practically, and they have acidic groups, such as carboxyl group substituted indole trimers and sulfonic group substituted indole trimers, Since it is water solubility and water can be used as a solvent, it can use preferably especially also from a field of safety to a human body and environment.

[0018]An indole-derivatives trimer (A) obtained by various synthetic methods, such as chemical composition and electrochemical composition, can be used for an indole-derivatives trimer (A) used by this invention.

[0019]Especially at this invention, it is a following general formula (5).

[Formula 10]



(5)

( $R^{37} - R^{40}$  among the above-mentioned formula) The straight chain of hydrogen and the carbon numbers 1-24, the alkyl group of branching and the straight chain of the carbon numbers 1-24, or the alkoxy group of branching, The straight chain of the carbon numbers 2-24 or the acyl group of branching, an aldehyde group, a carboxyl group, The straight chain of the carbon numbers 2-24 or the carboxylate group of branching, a sulfonic group, The straight chain of the carbon numbers 1-24 or the sulfonic ester group of branching, a cyano group, It is the substituent independently chosen from the group which consists of a hydroxyl group, a nitro group, an amino group, an amide group, and a halogen group, respectively. At least a kind of indole derivatives shown, The indole-derivatives trimer (A) obtained by making it react at least into a kind of oxidizer and the reaction mixture which contains a kind of solvent at least is used preferably.

[0020] Indole derivatives shown by a general formula (4) used with a synthetic method of the aforementioned indole-derivatives trimer (A), Specifically 4 \*\*MECHIRU Indore, 5 \*\*MECHIRU Indore, 6 \*\*MECHIRU Indore, 7 \*\*MECHIRU Indore, 4 \*\*ECHIRU Indore, 5 \*\*ECHIRU Indore, 6 \*\*ECHIRU Indore, 7 \*\*ECHIRU Indore, 4-n-propyl Indore, 5-n-propyl Indore, 6-n-propyl Indore, 7-n-propyl Indore, 4-iso-propyl Indore, 5-iso-propyl Indore, 6-iso-propyl Indore, 7-iso-propyl Indore, A 4-n-butylindole, a 5-n-butylindole, a 6-n-butylindole, A 7-n-butylindole, a 4-sec-butylindole, a 5-sec-butylindole, A 6-sec-butylindole, a 7-sec-butylindole, a 4-t-butylindole, Alkyl group substituted indole, such as a 5-t-butylindole, a 6-t-butylindole, and a 7-t-butylindole, 4 \*\*METOKISHI Indore, 5 \*\*METOKISHI Indore, 6 \*\*METOKISHI Indore, 7 \*\*METOKISHI Indore, 4 \*\*ETOKISHI Indore, 5 \*\*ETOKISHI Indore, 6 \*\*ETOKISHI Indore, 7 \*\*ETOKISHI Indore, 4-n-propoxy Indore, 5-n-propoxy Indore, 6-n-propoxy Indore, 7-n-propoxy Indore, 4-iso-propoxy Indore, 5-iso-propoxy Indore, 6-iso-propoxy Indore, 7-iso-propoxy Indore, 4-n-butoxy Indore, 5-n-butoxy Indore, 6-n-butoxy Indore, 7-n-butoxy Indore, 4-sec-butoxy Indore, 5-sec-butoxy Indore, 6-sec-butoxy Indore, 7-sec-butoxy Indore, 4-t-butoxy Indore, 5-t-butoxy Indore, 6-t-butoxy Indore, Alkoxy group substituted indole, such as 7-t-butoxy Indore. Acyl group substituted indole, such as 4 \*\*ASE chill indole, 5 \*\*ASE chill indole, 6 \*\*ASE chill indole, and 7 \*\*ASE chill indole, Indore 4 \*\*KARUBARUDEHIDO, Indore 5 \*\*KARUBARUDEHIDO, Indore 6 \*\*KARUBARUDEHIDO, Aldehyde group substituted indole, such as Indore 7 \*\*KARUBARUDEHIDO. Indore 4 \*\*KARUBON acid, Indore 5 \*\*KARUBON acid, Indore 6 \*\*KARUBON acid, Carboxyl group substituted indole, such as Indore 7 \*\*KARUBON acid. Indore 4 \*\*KARUBON acid methyl, Indore 5 \*\*KARUBON acid methyl, Carboxylate group substituted indole, such as Indore 6 \*\*KARUBON acid methyl and Indore 7 \*\*KARUBON acid methyl. Indore 4 \*\*SURUHON acid, Indore 5 \*\*SURUHON acid, Indore 6 \*\*SURUHON acid, Sulfonic group substituted indole, such as Indore 7 \*\*SURUHON acid. Indore 4 \*\*SURUHON acid methyl, Indore 5 \*\*SURUHON acid

methyl, Sulfonic ester group substituted indole, such as Indore 6 \*\*SURUHON acid methyl and Indore 7 \*\*SURUHON acid methyl. Cyano group substituted indole, such as Indore 4 \*\*KARUBO nitril, Indore 5 \*\*KARUBO nitril, Indore 6 \*\*KARUBO nitril, and Indore 7 \*\*KARUBO nitril, 4 \*\*HIDOROKISHI Indore, 5 \*\*HIDOROKISHI Indore, 6 \*\*HIDOROKISHI Indore, Hydroxy group substituted indole, such as 7 \*\*HIDOROKISHI indole, 4 \*\*NITORO Indore, Nitro group substituted indole, such as 5 \*\*NITORO Indore, 6 \*\*NITORO Indore, and 7 \*\*NITORO Indore. 4 \*\*AMINO Indore, 5 \*\*AMINO Indore, 6 \*\*AMINO Indore, Amino group substituted indole, such as 7 \*\*AMINO Indore, 4 \*\*KARUBA moil indole, Amide group substituted indole, such as 5 \*\*KARUBA moil indole, 6 \*\*KARUBA moil indole, and 7 \*\*KARUBA moil indole. 4 \*\*FURUORO Indore, 5 \*\*FURUORO Indore, 6 \*\*FURUORO Indore, 7 \*\*FURUORO Indore, 4 \*\*KURORO Indore, 5 \*\*KURORO Indore, 6 \*\*KURORO Indore, 7 \*\*KURORO Indore, 4 \*\*BUROMO Indore, Halogen group substituted indole, such as 5 \*\*BUROMO Indore, 6 \*\*BUROMO Indore, 7 \*\*BUROMO Indore, 4 \*\*YODO Indore, 5 \*\*YODO Indore, 6 \*\*YODO Indore, and 7 \*\*YODO Indore, can be mentioned.

[0021]In this, carboxyl group substituted indole and sulfonic group substituted indole. Cyano group substituted indole, nitro group substituted indole, amide group substituted indole, and halogen group substituted indole are preferred practically, and carboxyl group substituted indole and especially sulfonic group substituted indole are preferred.

[0022]An oxidizer used with a synthetic method of the aforementioned indole-derivatives trimer (A), Although not limited in particular, for example Ferric chloride 6 hydrate, the anhydrous salt-ized second iron, Second iron of nitric acid 9 hydrate, a ferric sulfate n hydrate, ferric-ammonium-sulfate 12 hydrate, A second iron [ of perchloric acid ] n hydrate, the second iron of tetrafluoroboric acid, a cupric chloride, The second copper of nitric acid, cupric sulfate, the second copper of tetrafluoroboric acid, nitroso tetrafluoroborate NIUMU, hydrogen peroxide, ammonium persulfate, sodium persulfate, potassium persulfate, potassium periodate, etc. can be mentioned. In this, ferric chloride 6 hydrate, the anhydrous salt-ized second iron, a cupric chloride, the second copper of tetrafluoroboric acid, and ammonium persulfate are preferred practically, and ferric chloride 6 hydrate, and the anhydrous salt-ized second iron are preferred most practically also in it. These oxidizers may be used independently, respectively, or may use together and use two or more sorts at an arbitrary rate.

[0023]a mole ratio of indole derivatives used with a synthetic method of the aforementioned indole-derivatives trimer (A), and an oxidizer — indole-derivatives:oxidizer = 1:0.5 – 100 — it is preferably used by 1:1–50. Here, if a rate of an oxidizer is low, reactivity falls, a raw material remains, a trimer generated when the rate was not much high conversely is peroxidated, and degradation of output may be caused.

[0024]Water and an organic solvent can be used for a solvent used with a synthetic method of the aforementioned indole-derivatives trimer (A). Although an organic solvent in particular is not limited, methanol, ethanol, isopropanol, Acetone, acetonitrile, propionitrile, a tetrahydrofuran, 1,4-dioxane, methyl isobutyl ketone, methyl ethyl ketone, gamma \*\*BUCHIRU lactone, propylene carbonate, sulfolane, nitromethane, N,N-dimethylformamide, N-methylacetamide, dimethyl sulfoxide, a dimethylsulfone, N-methyl pyrrolidone, benzene, toluene, xylene, a methylene chloride, chloroform, a dichloroethane, etc. are used. These solvents may be used independently, respectively, or may mix and use two or more sorts at an arbitrary rate. In these solvents, acetone, acetonitrile, 1,4-dioxane, gamma-butyllactone,

N,N-dimethylformamide, etc. are preferred, and especially acetonitrile is the most preferred practically.

[0025] Especially a thing you make water and an organic solvent live together, and is made they to react in a synthetic method of the aforementioned indole-derivatives trimer (A) is preferred. a use mole ratio of said indole derivatives and water — indole-derivatives:water = 1:1000–1000:1 — it is preferably used by 1:100 to 100:1. However, when an oxidizer has crystal water, the amount of crystal water is also measured as water. Here, if a rate of water is low, while a reaction will run recklessly, a trimer will be peroxidated and structure degradation will be carried out,  $X^{a-}$  which becomes a dopant to a trimer may be unable to dope efficiently, and conductivity may fall. Conversely, when the rate is too high, advance of oxidation reaction may be barred and a reaction yield may fall.

[0026] in a synthetic method of the aforementioned indole-derivatives trimer (A), concentration of indole derivatives of reaction time receives a solvent — more than 0.01 mass % — desirable — 0.1 – 50 mass % — it is the range of 1 – 30 mass % more preferably.

[0027]  $X^{a-}$  in general formula (2) indole-derivatives trimer (A) which is used by this invention and which is shown by – (4) is a dopant, and is the negative ion of proton acid originating in an oxidizer under polymerization, etc. Specifically A chloride ion, a bromine ion, iodine ion, a fluorine ion, Nitrate ion, sulfate ion, a sulfuric acid hydrogen ion, phosphoric acid ion, way fluoridation ion, A perchlorate ion, thiocyanic acid ion, acetate ion, propionic acid ion, It is 1 – trivalent negative ion, such as p-toluenesulfonic-acid ion, trifluoro acetate ion, and trifluoromethanesulfonic acid ion, and they are 1 – divalent negative ion, such as a chloride ion, sulfate ion, and the Howe fluoridation ion, preferably. Univalent negative ion of a chloride ion etc. is the most preferred. For example, when it polymerizes by choosing the anhydrous salt-ized second iron as an oxidizer, dopant  $X^{a-}$  in an indole-derivatives trimer becomes a chloride ion, and when it polymerizes using trifluoro cupric acetate, dopant  $X^{a-}$  becomes trifluoro acetate ion.

[0028] An indole-derivatives trimer (A) obtained with a synthetic method of the aforementioned indole-derivatives trimer (A), Except when using hydrogen peroxide and ozone as an oxidizer, it is a doped type indole-derivatives trimer (A), and mole-ratio (dope rate) m of dopant  $X^{a-}$  to the repeating unit is 0.001–0.5. It will be set to  $m=0$  if hydrogen peroxide or ozone is used as an oxidizer.

[0029] What carried out dedope processing in order to act as Kougami of the solubility to a solvent (B) more can be used for an indole-derivatives trimer (A). Although not limited especially as a disposal method of a dedope, a method publicly known as a dedope process of various conductive polymers and an electron donor acceptor complex is used, for example from the former. Namely, a method of making an indole-derivatives trimer (A) suspended and removing dopant  $X^{a-}$  in alkaline solutions, such as an ammonia solution, sodium hydroxide, a potassium hydrate, and lithium hydroxide, Or a method of obtaining a dedope type indole-derivatives trimer (namely, dope rate  $m=0$ ) by reduction processing is mentioned.

[0030] A dedope type indole-derivatives trimer is easily convertible for a doped type indole-derivatives trimer for which only arbitrary dope rates have arbitrary dopants by processing by dopant of an arbitrary kind and arbitrary quantity again. For example, a doped type indole-derivatives trimer which polymerized with an oxidizer which has counter ions other than a chloride ion, After dedoping with a sodium hydroxide solution and considering it as a dedope type indole-derivatives trimer, it is also possible to derive it to a hydrochloric acid aqueous solution by carrying out re-KEN \*\* to a chlorine dope type indole-derivatives trimer. Thus, a conductive composition of this invention, etc. can also be prepared using an

indole-derivatives trimer doped with obtained arbitrary dopants.

[0031]An indole-derivatives trimer (A) may be more excellent in conducting performance by having a laminated structure. It is preferred to have especially a laminated structure which is 0.1–0.6 nm of interlayer spacings. Such a compound that overly has a detailed laminated structure has good physical properties, such as rigidity, intensity, and heat resistance. However, it is in a tendency for an interlayer spacing to become more stable [ a laminated structure ] at 0.1 nm or more, and electronic hopping conduction between trimers becomes easier at 0.6 nm or less, and there is a tendency for conductivity to improve.

[0032]As a solvent (B) which constitutes a conductive composition of this invention, an indole-derivatives trimer (A), Especially if a cross linking agent (C), a silane coupling agent (D), colloidal silica (E), a basic compound (F), a high molecular compound (G), a surface-active agent (H), and mineral salt (I) are dissolved or distributed, it will not be limited, but water and an organic solvent are used. As an organic solvent, alcohols, such as methanol, ethanol, propanol, and isopropanol, Ketone, such as acetone and methyl isobutyl ketone, isopropyl ether, Ether, such as methyl t \*\*BUCHIRU ether, methyl cellosolve, Cellosolves, such as ethylcellosolve, methylpropylene glycol, Pyrrolidones, such as amide, such as propylene glycols, such as ethylpropylene glycol, dimethylformamide, and dimethylacetamide, N-methyl pyrrolidone, and N-ethylpyrrolidone, are used preferably. Water, methanol, isopropanol, acetone, dimethylformamide, dimethylacetamide, and N-methyl pyrrolidone are more preferred especially in respect of [ to an indole-derivatives trimer ] solubility. These solvents may be used independently, respectively, or at an arbitrary rate, it may mix and they may be used.

[0033]A using rate of an indole-derivatives trimer (A) is 0.1 – 10 mass part preferably 0.01 to 20 mass part to solvent (B) 100 mass part. In 20 or less mass parts, solubility is good and rate of conductivity of an indole-derivatives trimer (A) improves more.

[0034]When a conductive composition of this invention adds a cross linking agent (C) which is an indispensable constituent, the solvent resistance of a conductor and a water resisting property which are formed from this conductive composition are given.

[0035]Although a cross linking agent (C) in particular that is an indispensable constituent is not limited, what the cross linking agent itself carries out crosslinking reaction between molecules, and forms three-dimensional network structure, or reacts to other ingredients, such as an indole-derivatives trimer (A) and a high molecular compound (G), and forms a crosslinking bond is used. Either an indole-derivatives trimer (A) or a high molecular compound (G) both, and a thing that constructs a bridge are especially more preferred from solvent resistance and a waterproof viewpoint.

[0036]. [ which it reacts and can form a crosslinking bond as a cross linking agent (C) of this invention ] For example, an acrylic group, a vinyl group, an epoxy group, an isocyanate group, an oxazoline group, A silanol group, an acid chloride group, a carboxyl group, an amino group, a hydroxyl group, Although it is protected and does not react under the usual conditions into solvents, such as a compound which has two or more reactant groups, such as a sulfhydryl group, in intramolecular, or water, it is a compound which has in intramolecular two or more bases reproduced to the above-mentioned reactant groups, such as an isocyanate group, by processing of heating, pH adjustment, etc. As such a compound, a polyfunctional vinyl compound, a polyfunctional acrylic compound, A polyfunctional epoxy compound, a polyfunctional isocyanate compound, a polyfunctional oxazoline compound, a polyfunctional carboxylic acid compound, a

polyfunctional amine compound, a polyfunctional hydroxy compound, a polyfunctional mercapto compound, a silane coupling agent (D), etc. are mentioned.

[0037] A bisphenol A system epoxy resin which used bisphenol A as a starting material as a polyfunctional epoxy compound, Sorbitol polyglycidyl ether, polyglycerol polyglycidyl ether, Pentaerythritol polyglycidyl ether, diglycerol polyglycidyl ether, Glycerol polyglycidyl ether, triglycidyl tris (2-hydroxyethyl) isocyanurate, Trimethylolpropane polyglycidyl ether, resorcinol diglycidyl ether, Neopentyl glycol diglycidyl ether, 1, 6-hexanediol diglycidyl ether, Bisphenol S-diglycidyl ether, hydrogenation bisphenol A diglycidyl ether, Ethylene glycol diglycidyl ether, polyethylene glycol diglycidyl ether, Polypropylene glycol diglycidyl ether, propylene glycol diglycidyl ether, Polytetramethylene glycol diglycidyl ether, adipic acid glycidyl ester, o-phthalic acid glycidyl ester, dibromoneopentylglycol diglycidyl ether, allyl glycidyl ether, 2-ethylhexyl glycidyl ether, phenyl glycidyl ether, Phenol (EO)<sub>5</sub> glycidyl ether, p-t-buthylphenyl glycidyl ether, Lauryl alcohol (EO)<sub>15</sub> glycidyl ether, hydroquinone diglycidyl ether, diglycidyl terephthalate, N-glycidyl phthalimide, etc. are raised.

[0038] As for the above-mentioned polyfunctional epoxy compound, it is possible to add and to also make a compound which has other active hydrogen react besides reacting to an indole-derivatives trimer (A) and/or a high molecular compound (G) which live together. As such a compound, for example Diethylenetriamine, triethylenetetramine, Tetraethylenepentamine, polyoxypropylene polyamine, triethylene glycoldiamine, Aliphatic polyamine, such as tetraethylene glycoldiamine, xylylene diamine, Annular polyamine, such as spiroacetaldiamine, isophoronediamine, and bis(3-methyl-4-aminocyclohexyl)methane, Denaturation amine, such as polyaminoamide, an amine adduct hardening agent, a MANNIHHI mold-curing agent, etc. which have many activity amino groups, etc. are raised to intramolecular compounded by condensation with aromatic polyamine, such as diaminodiphenylmethane and diaminodiphenyl sulfone, polyamine, and dicarboxylic acid.

[0039] As a polyfunctional isocyanate compound, 3 or a thing contained four pieces can be preferably used for two or more isocyanate groups into a molecule. Specifically 2, 4-tolylene diisocyanate (2, 4-TDI), 2,6-tolylene diisocyanate (2,6-TDI), the diphenylmethane 4, 4'-diisocyanate (MDI), The hydrogenation MDI, 1,5-naphthalene diisocyanate, xylylene diisocyanate (XDI), An isocyanate compound of aromatic systems, such as the hydrogenation XDI, meta-xylylene diisocyanate (MXDI), and a 3,3'-dimethyl- 4,4'-JIFENIRI range isocyanate (TODI), Isophorone diisocyanate (IPDI), trimethyl hexamethylene di-isocyanate (TMDI), Isocyanate compounds of aliphatic series systems, such as hexamethylene di-isocyanate (HDI), and these adduct objects, a biuret object, an isocyanurate object, etc. are used preferably. As for a molecular weight of a polyfunctional isocyanate compound, generally, 500 to about 1000 are preferred.

[0040] For example, it can obtain as Hellas TRON (a trade name and Dai-Ichi Kogyo Seiyaku Co., Ltd.) which is thermal reaction type water solubility urethane resin. This is the reactant urethane resin devised so that an end isocyanate group might be protected by blocking agent and could deal with it stably also in underwater. a blocking agent of the Hellas TRON — carbamoyl — a sulfonate group (—NHCOSO<sub>3</sub> —) — a compound which has a powerful hydrophilic radical is used. The Hellas TRON has the fixed feature by which a blocking agent will dissociate and an active isocyanate group will be reproduced if heat-treated. Predrying is carried out below 100 °C and, specifically, the Hellas TRON forms a polyurethane tunic which carried out self-crosslinking reaction between molecules and had the three-dimensional network structure by an

isocyanate group reproduced independently in itself by heat treatment for several minutes of 120 to 170 \*\*. If it heat-treats by mixing with other active hydrogen containing compounds, those compounds can be reformed according to bridge construction.

[0041]As a polyfunctional vinyl compound, polybutadiene, isoprene, etc. are mentioned, for example.

[0042]As a polyfunctional acrylic compound, specifically, Bisphenol F EO denaturation (4 mol) diacrylate (M-208), Bisphenol A EO denaturation (4 mol) diacrylate (M-210), Isocyanuric acid EO denaturation diacrylate (M-215), tripropylene glycol diacrylate (M-220), Polypropylene-glycol diacrylate (n is about 7, PPG#400, and M-225), Pentaerythritol diacrylate monostearate (M-233), Polyethylene-glycol diacrylate (n is about 4, PPG#200, and M-240), Polyethylene-glycol diacrylate (n is about 9, PPG#400, and M-245), Polyethylene-glycol diacrylate (n is about 13-14, PPG#600, and M-260), Polypropylene-glycol diacrylate (n is about 12 and M-270), pentaerythritol — doria — KURIRETO (M-305) and trimethylolpropane triacrylate (M-309) — (M-310) (M-315), and, [ trimethylolpropane PO denaturation (3 mol) doria ] [ isocyanuric acid EO denaturation doria ] (M-320), and, [ trimethylolpropane PO denaturation (6 mol) doria ] (M-350), and, [ trimethylolpropane EO denaturation (3 mol) doria ] (M-360), and, [ trimethylolpropane EO denaturation (6 mol) doria ] Dipentaerythritol penta and hexa acrylate (M-400), Ditrimehylolpropanetetraacrylate (M-408), pentaerythritol tetraacrylate (M-450), Urethane acrylate (M-1100) and polyester acrylates (M-7000 series, M-8000 series, M-7100, M-8060) are mentioned.

[0043]As a polyfunctional oxazoline compound, the EPO crossing (a trade name, the NIPPON SHOKUBAI Co., Ltd. make) etc. are mentioned, for example.

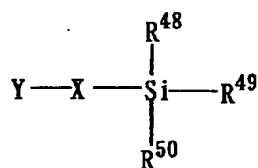
[0044]As a polyfunctional carboxylic acid compound, trimellitic anhydride, pyromellitic dianhydride, trimesic acid, etc. are mentioned, for example.

[0045]As a polyfunctional amine compound, polyamine or a polyamide amine compound like bar SAMIN and bar SAMIDO (a trade name, made in Henkel KGaA Japan), diethylenetriamine, triethylenetetramine, etc. are mentioned, for example.

[0046]As a polyfunctional hydroxy compound, for example Polyvinyl alcohol, Polyether polyol, polyester polyol, acrylic polyol, polycarbonatediol, trimethylolethane, trimethylolpropane, glycerin, pentaerythritol, etc. are mentioned.

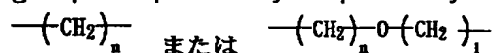
[0047]As a polyfunctional mercapto compound, TORIBI nil cyclohexane denaturation trimethylene diol etc. are mentioned, for example.

[0048]A silane coupling agent (D) shown by a general formula (1) as a silane coupling agent (D), [Formula 11]



(1)

(R<sup>48</sup>, R<sup>49</sup>, and R<sup>50</sup> are the bases as which a straight chain of hydrogen and the carbon numbers 1-6 and were chosen from a group which it becomes from an alkyl group of branching, a straight chain of the carbon numbers 1-6 or an alkoxy group of branching, an amino group, an acetyl group, a phenyl group, and a halogen group independently respectively among the above-mentioned formula.) X[Formula 12]





An example, and n and l are the numbers to 1-6. Y is the basis chosen from the group which consists of a hydroxyl group, a thiol group, an amino group, an epoxy group, and an epoxycyclohexyl group. It is used.

[0049]A thing with the hydroxyl group, the thiol group, the amino group, epoxy group, or epoxycyclohexyl group in which the silane coupling agent (D) which is a constituent of this invention is shown by said general formula (1) is used. As what specifically has an epoxy group, gamma-glycidyloxypropyl trimethoxysilane, gamma-glycidyloxy propylmethyl dimethoxysilane, gamma-glycidyloxy propyl triethoxysilane, etc., As a thing with an amino group, gamma-aminopropyl triethoxysilane, beta-aminoethyl trimethoxysilane, gamma-aminopropoxy propyltrimethoxysilane, etc., As a thing with a thiol group, gamma-mercapto propyltrimethoxysilane, As a thing with a hydroxyl group, beta-mercaptoethyl methyl dimethoxysilane etc. beta-hydroxyethoxyethyl triethoxysilane, beta-(3, 4-epoxycyclohexyl) ethyltrimethoxysilane etc. are mentioned as a thing with epoxycyclohexyl groups, such as gamma-hydroxypropyl trimethoxysilane.

[0050]A cross linking agent (C) of this invention melts into a solvent (B) used at the time of conductive layer formation, and if stable, it is usable in anythings. Especially A polyfunctional epoxy compound, a polyfunctional isocyanate compound, a polyfunctional hydroxy compound, A silane coupling agent (D) is preferred and a drainage system polyfunctional epoxy compound meltable to especially water and stable, a drainage system polyfunctional isocyanate compound, a drainage system polyfunctional hydroxy compound, and a drainage system silane coupling agent are preferred.

[0051]In the above-mentioned polyfunctional reactivity group content compound, a monovinyl compound, a mono- acrylic compound, A mono epoxy compound, a mono- isocyanate compound, a mono- oxazoline compound, a monocarboxylic acid compound, a monoamine compound, a mono- hydroxy compound, a mono- mercapto compound, etc. may also be included.

[0052]Self-bridge construction of an indole-derivatives trimer (A) and/or the high molecular compound (G) can be carried out, and a bridge can also be constructed more firmly. It is required for these compounds (A) and (G) to have a cross-linking reaction group for that purpose, and as such a cross-linking reaction group, For example, an acrylic group, a vinyl group, an epoxy group, an isocyanate group, an oxazoline group, a silanol group, an acid chloride group, a carboxyl group, an amino group, a hydroxyl group, a sulfhydryl group, etc. are mentioned.

[0053]Although water and an organic solvent may wash a conductor obtained from a conductive composition of this invention depending on a use at the time of use, By hardening by a cross linking agent (C), it is effective in it not only being able to preventing a fall of an antielectricity characteristic by grant of a water resisting property or solvent resistance, but water and a solvent to a transparent conductive film shaking off, and a sex becoming good. By bridge construction hardening, since a coefficient of water absorption of water or a solvent is not swelling few, the transparent conductive film can shorten drying time. It is effective in being few with a crack at the time of rinsing with little adhesion of garbage.

[0054]However, since a conductive layer cannot follow elongation but a fall of an antielectricity characteristic in an extension portion will take place when a conductor is elongated by processing etc. if bridge construction hardening is too strong, it is preferred to carry out bridge construction hardening so that a surface resistance value may not become larger than 10 times, when it elongates 150%.

[0055]An ingredient (C) is 0.001 - 20 mass part to ingredient (B) 100 mass part, and a using rate of said ingredient (C) and an ingredient (B) is 0.01 - 15 mass part preferably. Of less than 0.001 mass part of

ingredients (C), when improvement width of a water resisting property and/or solvent resistance is comparatively small and 20 mass parts are exceeded on the other hand, solubility, surface smoothness, transparency, and conductivity may get worse.

[0056]An ingredient (D) is 0.001 – 20 mass part to ingredient (B) 100 mass part, and a using rate of said ingredient (D) and an ingredient (B) is 0.01 – 15 mass part preferably. Of less than 0.001 mass part of ingredients (D), when improvement width of a water resisting property and/or solvent resistance is comparatively small and 20 mass parts are exceeded on the other hand, solubility, surface smoothness, transparency, and conductivity may get worse.

[0057]If a conductive composition of this invention adds colloidal silica (E) further, surface hardness and weatherability of a conductor which are obtained from a conductive composition will improve remarkably.

[0058]Although colloidal silica (E) in particular used for this invention is not limited, what is distributed by mixed solvent of water, an organic solvent or water, and an organic solvent is used preferably. Although not limited, especially as an organic solvent For example, methanol, ethanol, Alcohols, such as isopropyl alcohol, propyl alcohol, butanol, and a pentanol, Ketone, such as acetone, methyl ethyl ketone, ethyl isobutyl ketone, and methyl isobutyl ketone. Ethylene glycol, such as ethylene glycol, ethylene glycol methyl ether, and ethylene glycol mono-n-propyl ether. Propylene glycols, such as propylene glycol, propylene glycol methyl ether, propylene glycol ethyl ether, propylene glycol butyl ether, and propylene glycol propyl ether, are used preferably.

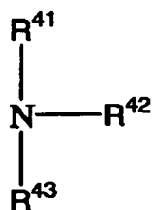
[0059]As particle diameter of colloidal silica (E), a thing (1 nm – 300 nm) is used, and 1 nm – 150 nm of things of the range of 1 nm – 50 nm are used still more preferably preferably. If particle diameter is too large here, hardness will run short, and the solution stability of colloidal silica itself will also fall.

[0060]0.001 – 100 mass part has a preferred ingredient (E) to ingredient (B) 100 mass part, and a using rate of said ingredient (E) and an ingredient (B) is 0.01 – 50 mass part more preferably. When a water resisting property, weatherability, and improvement width of hardness are large of 0.001 or more mass parts of ingredients (E) and 100 mass parts are exceeded on the other hand, solubility, surface smoothness, transparency, and conductivity may get worse.

[0061]By adding in a conductive composition, a basic compound (F) which constitutes a conductive composition of this invention dedopes an indole-derivatives trimer (A), and is effective in raising solubility to a solvent (B) more. In a case of carboxyl group substituted indole trimers and sulfonic group substituted indole trimers, solubility to water improves specially by forming a sulfonic group and a carboxyl group, and a salt. Especially as a basic compound (F), although not limited, amines and ammonium salt are used preferably, for example.

[0062]A structural formula of amines used as a basic compound (F) is shown in a lower type.

[Formula 13]

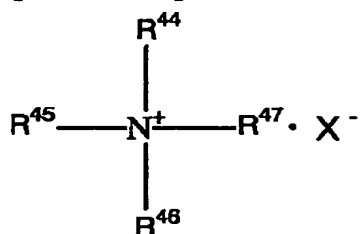


(6)

$R^{41} - R^{43}$  express hydrogen, the alkyl group of the carbon numbers 1-4 ( $C_1 - C_4$ ),  $CH_2 OH$ ,  $CH_2CH_2 OH$ ,  $CONH_2$ , or  $NH_2$  mutually-independent respectively among a formula.

[0063]The structural formula of ammonium salt used as a basic compound (F) of this invention is shown in a lower type.

[Formula 14]



(7)

Respectively  $R^{44} - R^{47}$  mutually-independent among a formula Hydrogen, the alkyl group of the carbon numbers 1-4 ( $C_1 - C_4$ ), Express  $CH_2 OH$ ,  $CH_2CH_2 OH$ ,  $CONH_2$ , or  $NH_2$ , and;  $X^- OH^-$ ,  $1/2$  and  $SO_4^{2-}$ , and  $NO_3^-$ ,  $1/2CO_3^{2-}$ ,  $HCO_3^-$ ,  $1/2$  and  $(COO)_2^{2-}$ , or  $R'COO^-$  [— the inside of a formula, and  $R - ' -$ ] which is an alkyl group of the carbon numbers 1-3 ( $C_1 - C_3$ ) is expressed.

[0064]A basic compound (F) may mix two or more sorts, and may be used. For example, conductivity can be further raised by mixing and using amines and ammonium salt. Specifically  $NH_3/(NH_4)_2CO_3$ ,  $NH_3/(NH_4)HCO_3$  and  $NH_3/CH_3COONH_4$ ,  $NH_3/(NH_4)_2SO_4$ ,  $N(CH_3)_3/CH_3COONH_4$ ,  $N(CH_3)_3/(NH_4)_2SO_4$ , etc. are mentioned. Although these mixture ratio can be used at an arbitrary rate,  $= [ \text{amines/ammonium salt} ] 1 / 10 - 10/0$  are preferred.

[0065]A using rate of a basic compound (F) has 0.1 – 10 preferred mass part to solvent (B) 100 mass part, and is 0.1 – 5 mass part more preferably. When a rate of a basic compound (G) is ten or less mass parts, it is preferred that both solubility and conductivity are excellent etc.

[0066]A high molecular compound (G) which constitutes said conductive composition and a conductor of this invention will not be limited especially if a thing to dissolve in a solvent (B) or an emulsion is formed. For example, polyvinyl alcohol, such as polyvinyl alcohol, a polyvinyl formal, and a polyvinyl butyral. Poly acrylamide, poly (N-t-butyl acrylamide), Poly acrylamide, such as poly acrylamide methylpropanesulfonic acid. Polyvinyl pyrrolidones, alkyd resin, melamine resin, urea resin, Phenol resin, an epoxy resin, a polybutadiene resin, an acrylic resin, Urethane resin, vinyl ester resin, a urea resin, polyimide resin, Maleic acid resin, polycarbonate resin, vinyl acetate resin, chlorinated polyethylene resin, Chlorinated polypropylene resin, an acrylic / styrene copolymerization resin, vinyl acetate / acrylic copolymerization resin, polyester resin, styrene / maleic acid copolymerization resin, fluoro-resins, these copolymers, etc. are used. These high molecular compounds (G) may mix two or more sorts at an arbitrary rate.

[0067]A high molecular compound which forms an emulsion by water soluble polymer compound or a drainage system also in these high molecular compounds (G) is used preferably, and a high molecular compound which has an anion group preferably especially is used. It is preferred to mix and use one sort in a drainage system acrylic resin, drainage system polyester resin, drainage system urethane resin, and drainage system chlorinated polyolefin resin or two sorts or more also in it.

[0068]A using rate of a high molecular compound (G) has 0.1 – 400 preferred mass part to solvent (B) 100 mass part, and is 0.5 – 300 mass part more preferably. In 0.1 or more mass parts, membrane formation

nature, a moldability, and intensity improve more, when it is 400 or less mass parts on the other hand, there are few falls of the solubility of an indole-derivatives trimer (A), and high conductivity is maintained.

[0069] Although it is possible only for the ingredient of cross linking agents (C), such as an indole-derivatives trimer (A), a solvent (B), and a silane coupling agent (D), colloidal silica (E), a basic compound (F), and a high molecular compound (G) to form a powerful film as for a conductive composition of this invention, If a surface-active agent (H) is added, surface smoothness, spreading nature, conductivity, etc. will improve further. A surface-active agent (H) which are a conductive composition of this invention, and an ingredient of a conductor, Alkyl sulfonic acid, alkylbenzene sulfonic acid, alkyl carboxylic acid, Alkyl naphthalene sulfonic acid, alpha olefin sulfonic acid, dialkyl sulfosuccinic acid, alpha-sulfonation fatty acid, N-methyl-N-oleyltaurine, petroleum sulfonic acid, Alkyl sulfuric acid, sulfated oil fat, polyoxyethylene-alkyl-ether sulfuric acid, Polyoxyethylene styrene-ized phenyl ether sulfuric acid, alkyl phosphoric acid, Polyoxyethylene-alkyl-ether phosphoric acid, polyoxyethylene-alkyl-phenyl-ether phosphoric acid, Anionic system surface-active agents, such as naphthalene sulfonic acidformaldehyde condensates and these salts, The first - the third fatty amine, quaternary ammonium, tetra alkylammonium, A urea condensate of trialkyl benzylammonium alkyl pyridinium, 2-alkyl 1-alkyl 1-hydroxyethyl imidazolinium, N,N-dialkyl mol HORINIUMU, polyethylene polyamine fatty acid amide, and polyethylene polyamine fatty acid amide, Cation system surface-active agents, such as quaternary ammonium of a urea condensate of polyethylene polyamine fatty acid amide, and these salts, N,N-dimethyl- N-alkyl N-carboxymethyl ammonium betaine, N,N,N-trialkyl N-sulfo alkylene ammonium betaine, The N and N-dialkyl N, N-bispolyoxyethylene ammonium sulfate ester betaine, Betaines, such as 2-alkyl 1-carboxymethyl 1-hydroxyethyl imidazolinium betaine. Ampholytic surface active agents, such as aminocarboxylic acid, such as N,N-dialkylamino alkylene carboxylate, Polyoxyethylene alkyl ether, polyoxyethylene alkyl phenyl ether, Polyoxyethylene poly styryl phenyl ether, polyoxyethylene polyoxypropylene glycol, Polyoxyethylene polyoxypropylene alkyl ether, polyhydric alcohol fatty acid part ester, Polyoxyethylene polyhydric alcohol fatty acid part ester, polyoxyethylene fatty acid ester, polyglyceryl fatty acid ester, polyoxyethylene-ized castor oil, fatty acid diethanolamide, Polyoxyethylene alkylamine, triethanolamine fatty acid part ester, Fluorochemical surfactants, such as non-ion system surface-active agents, such as trialkyl amine oxide, and fluoro alkyl carboxylic acid, perfluoroalkyl carboxylic acid, perfluoroalkyl benzenesulfonic acid, and perfluoroalkyl polyoxyethyleneethanol, are used. Here, the carbon numbers 1-24 of an alkyl group are preferred, and its carbon numbers 3-18 are more preferred. Even if it uses two or more sorts of surface-active agents, they do not interfere at all.

[0070] A using rate of a surface-active agent (H) has 0.1 - 10 preferred mass part to solvent (B) 100 mass part, and is 0.1 - 5 mass part more preferably.

[0071] If mineral salt (I) is added further, solubility of a conductive composition of this invention of an indole-derivatives trimer (A) to a solvent (B) will improve. Although mineral salt (I) in particular is not limited, alkali metal salt, alkaline earth metal salt, etc. are used preferably. For example, a lithium chloride, a lithium bromide, lithium iodide, lithium hydroxide, lithium carbonate, a lithium nitrate, oxalic acid lithium, lithium phosphate, and lithium sulfate are used preferably. Even if it uses two or more sorts of mineral salt, it does not interfere at all.

[0072] A using rate of mineral salt (I) has 0.1 - 5 preferred weight section to solvent (B) 100 weight section,

and is 0.1 – 3 weight section more preferably.

[0073]A conductive composition of this invention can be made to contain a conductive substance in order to raise the conductivity further. As a conductive substance, metal, such as metallic oxides, such as carbon system material, such as conductive carbon black and black lead, tin oxide, and a zinc oxide, silver, nickel, and copper, is mentioned.

[0074]In a conductive composition furthermore used for this invention, preservation stabilizer, a bonding assistant, a color, paints, etc. can be added if needed.

[0075]A conductive composition by this invention Cross linking agents (C), such as an indole-derivatives trimer (A), a solvent (B), and a silane coupling agent (D), As occasion demands, it is under a room temperature, or heating stirring of colloidal silica (E), a basic compound (F), a high molecular compound (G), a surface-active agent (H), and/or mineral salt (I) is carried out, and it dissolves thoroughly, or mixes and prepares. A conductor of this invention can be formed by applying to a substrate a conductive composition prepared as mentioned above.

[0076]Although a conductor of this invention has the conductivity excellent also in as [ this ], After applying a conductive composition and forming a transparent conductive film on at least one field of a substrate, conductivity can be further raised by acid's performing doping processing and subsequently carrying out neglect or heat-treatment at ordinary temperature.

[0077]Although it is not limited in particular for a doping disposal method by acid and a publicly known method can be used, doping processing can be performed by processing making a conductor immersed into an acidic solution etc. for example. An acidic solution specifically Inorganic acid, such as chloride, sulfuric acid, and nitric acid, and p-toluenesulfonic acid, Organic acid, such as a derivative which has camphor sulfonic acid, benzoic acid, and these skeletons, They are solution containing polymer acid, such as a derivative which has polystyrene sulfonate, polyvinyl sulfonic acid, poly(2-acrylamide isobutane) sulfonic acid, polyvinyl sulphates, and these skeletons, or a mixed solution of a water-organic solvent. These inorganic acid, organic acid, and polymer acid may be used independently, respectively, or may mix and use two or more sorts at an arbitrary rate.

[0078]A conductive composition is processible on the surface of a substrate by a method used for a general paint as a formation method of a conductor of this invention. For example, a photogravure coating machine, a roll coater, a curtain flow coater, A spin coater, a bar coating machine, a reverse coating machine, a kis coating machine, Dip coating, such as atomizing processes, such as the applying methods, such as a fan ten coating machine, a rod coating machine, an exhaust air doctor coating machine, a knife coating machine, a braid coating machine, cast coating, and screen coating, and spray coating, and dip, etc. are used.

[0079]Although a transparent conductive film formed with a conductive composition of this invention can be formed to 0.01–1000 micrometers of thickness, Since there is a tendency for the transparency of a transparent conductive film to fall when thickness is large, a thing thin if possible is usually preferred, and it is preferably good the range of 0.01–500 micrometers, and to consider it as the range of 0.02–100 micrometers more preferably. In order to obtain a transparent conductive film of the above-mentioned thickness, it is preferred to make viscosity of a conductive composition into the range of 1 – 500cp preferably, and to make it into the range of 0.1 to 80 % of the weight of the amounts of solid content 1000 or less cp.

[0080]As for a conductor which has a transparent conductive film of this invention, it is preferred that surface resistance values in low humidity conditions (for example, temperature 25 \*\*, relative humidity 15%) are  $10^5 - 10^{12}$  ohm, and also it is more preferred to have the performance of  $10^5 - 10^{10}$  ohm.

[0081]A conductor which has a transparent conductive film of this invention needs to have a water resisting property and/or solvent resistance outstanding depending on a use. A water resisting property and/or solvent resistance need to be given so that there may be no degradation, such as conductivity by immersion to water or a solvent, for that purpose. As a water resisting property and solvent resistance, it is temperature. It is preferred that a rate of change (SR1/SR0) of a surface resistance value (SR1) after being immersed into a 40 \*\* solvent to a surface resistance value (SR0) before immersion for 1 hour is less than ten, and also it is more preferred that a rate of change is less than five.

[0082]As a substrate which carries out coating of the conductive composition, a high molecular compound, wood, a paper material, ceramics and its film or a glass plate, a firing object, a porous body, an elastomer, etc. are used. As a high molecular compound and a film, for example, polyethylene, polyvinyl chloride, Polypropylene, polystyrene, polyester, ABS plastics, an AS resin, Methacrylic resin, polybutadiene, polycarbonate, polyarylate, Polyvinylidene fluoride, polyamide, polyimide, polyaramide, a polyphenylene sulfide, A polyether ether ketone, polyphenylene ether, polyether nitril, polyamidoimide, polyether sulphone, Pori Sall John, polyether imide, polybutylene terephthalate, its film, etc. exist. It is preferred a corona surface treatment or to carry out plasma treatment of the above-mentioned film surface in order for these high polymer films to make a transparent conductive poly membrane form in the one field at least, and to raise the adhesion of this poly membrane. After forming a transparent conductive film in a substrate, a conductor whose performance improved is formed by heating by a retained material of a basic compound (F) decreasing, and conductivity's improving, and heat-treating 250 \*\* or less in 40-200 \*\* preferably.

[0083]

[Example]An example explains this invention still more concretely below.

[0084]In the example of indole-derivatives trimer composition, ultimate analysis measurement is thermostat Qwest, Inc. make. It measured by EA1110. Conductivity measurement was measured by Mitsubishi Chemical Loles Tarr meter MCP-T350 (4 terminal method: 1 mm of inter electrode distance). The X-ray diffraction analysis (XRD) was measured by RINT-1100 (bulb:  $\text{CuK}_{\alpha}$  X-rays) by Rigaku Corp.

[0085]10 ml of acetonitrile was put into the 3 Thu mouth flask of 200 ml of composition of a synthetic example 1 indole- 5-carboxylic acid trimer, and the indole- 5-carboxylic acid 1.42g was dissolved. On the other hand, to 40 ml of acetonitrile, preparation of an oxidizer solution dissolved the anhydrous salt-ized second iron 16.2g, and the water 5.4g, and stirred them for 10 minutes. Next, after applying to indole- 5-carboxylic acid solution for 30 minutes and dropping the prepared oxidizer solution, it stirred at 60 \*\* for 10 hours. The reaction solution changed from thin yellow to light green, being accompanied by some generation of heat, and the pH was one or less. Carry out suction filtration by the Kiriama funnel after ending reaction, and it washes and dries with methanol by the acetonitrile following \*\*, Light green 6,11-dihydro-5H \*\*JIINDORO [ 2,3-a:2',3'-] [c] carbazole 2,9,14-tricarboxylic acid and 1.12 (indole- 5-carboxylic acid trimer) g (79% of yield) were obtained. It was 0.41 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of

ultimate analysis was  $_3(C_{9.00}H_{4.90}N_{1.09}O_{1.98}Cl_{0.11})$ . The interlayer spacing was 0.48 nm as a result of X diffraction crystal analysis.

[0086]It polymerized by the same method as the synthetic example 1 except using indole- 5-sulfonic acid instead of indole- 5-carboxylic acid in the example 1 of synthetic composition of a synthetic example 2 indole- 5-sulfonic acid trimer. Green 6,11-dihydro-5H \*\*JIINDORO [ 2,3-a:2',3'-] [c] carbazole 2,9,14-trisulfonic acid and 1.01 (indole- 5-sulfonic acid trimer) g (71% of yield) were obtained. It was 0.56 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was  $_3(C_{8.00}H_{4.85}N_{1.06}O_{3.01}S_{1.06}Cl_{0.11})$ .

[0087]It polymerized by the same method as the synthetic example 1 except using indole- 5-carbonitrile instead of indole- 5-carboxylic acid in the example 1 of synthetic composition of a synthetic example 3 indole- 5-carbonitrile trimer. Green 6,11-dihydro-5H \*\*JIINDORO [ 2,3-a:2',3'-] [c] carbazole 2,9,14-TORIKARUBO nitril and 1.22 (indole- 5-carbonitrile trimer) g (86% of yield) were obtained. It was 0.50 S/cm, when application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method. The result of ultimate analysis was  $_3(C_{9.00}H_{4.03}N_{1.97}Cl_{0.10})$ . The interlayer spacing was 0.44 nm as a result of X diffraction crystal analysis.

[0088]It was made to distribute in 1M ammonia solution, and 1.00 g of indole- 5-carbonitrile trimers compounded in the example 7 of synthetic composition of the indole- 5-carbonitrile trimer of a synthetic example 4 dedope state were stirred for 1 hour. carrying out suction filtration by the Kiriama funnel after stirring — water — subsequently methanol washed, it dried and 0.95 g of indole- 5-carbonitrile trimers of a black dedope state were obtained. When application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method, it was 0.04 or less S/cm. The result of ultimate analysis was  $_3(C_{9.00}H_{4.02}N_{2.02})$ .

[0089]It is synthetic aniline 100mmol of poly aniline of a synthetic example 5 dedope state at 25 \*\* 1 mol/L. The stirring dissolution was carried out and the solution of ammonium-peroxodisulfate 100mmol was dropped at sulfuric acid solution. After the end of dropping, and after stirring further at 25 \*\* for 12 hours, the resultant was dried after [ classified by \*\* ] washing, and the polymer powder 8g was obtained. When application-of-pressure molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method, it was 1.0 or less S/cm. After carrying out distributed stirring of this polymer in 1 mol/L ammonia solution at 25 \*\* in 1 hour, it dried after [ classified by \*\* ] washing, and the polymer powder 5g of a dedope state was obtained.

[0090]Composition of synthetic example 6 poly (2-sulfo- 5-methoxy-1,4-imino phenylene) (sulfonation poly aniline)

The stirring dissolution of the 2-aminoanisole 4-sulfonic acid 100mmol was carried out at 25 \*\* at the aqueous ammonia solution of 4 mol/L, and the solution of ammonium-peroxodisulfate 100mmol was dropped. After the end of dropping, and after stirring further at 25 \*\* for 12 hours, the resultant was dried after [ classified by \*\* ] washing, and the polymer powder 15g was obtained. When application-of-pressure

molding of the obtained trimer was carried out with the tablet molding machine, it started in 10 mm in diameter, and 1-mm-thick shape and conductivity was measured with the four probe method, it was 0.11 or less S/cm.

[0091]Example 1 (conductive composition 1)

The 6,11-dihydro-5H **\*\*JIINDORO** [2,3-a:2',3'-c] carbazoles 2 and 9 of the above-mentioned synthetic example 1, 14-tricarboxylic acid, (Indole- 5-carboxylic acid trimer) The stirring dissolution of 0.2 mass part and the 1,6-hexanediol-diglycidyl-ether 0.5 mass part was carried out at the room temperature at dimethylformamide 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried in 150 **\*\*x** 5 minutes. The water-white film of smooth surface resistance value  $6.9 \times 10^8 \Omega$  of the surface of 0.1 micrometer of thickness was obtained.

[0092]Example 2 (conductive composition 2)

The stirring dissolution of indole- 5-carboxylic acid trimer 5 mass part, gamma-glycidyloxypropyl trimethoxysilane 0.5 mass part, and the ammonia 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried in 80 **\*\*x** 5 minutes. The water-white film of smooth surface resistance value  $4.8 \times 10^6 \Omega$  of the surface of 3.5 micrometers of thickness was obtained.

[0093]Example 3 (conductive composition 3)

Indole- 5-carboxylic acid trimer 3 mass part, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, The stirring dissolution of gamma-glycidyloxypropyl trimethoxysilane 0.5 mass part and the ammonia 1.0 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried in 100 **\*\*x** 5 minutes. The water-white film of smooth surface resistance value  $4.2 \times 10^7 \Omega$  of the surface of 3.0 micrometers of thickness was obtained.

[0094]Example 4 (conductive composition 4)

The stirring dissolution of indole- 5-carboxylic acid trimer 5 mass part, gamma-glycidyloxypropyl trimethoxysilane 0.5 mass part, colloidal silica (particle diameter: 20 nm) 5 mass part, and the ammonia 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried in 25 **\*\*x** 5 minutes. The water-white film of smooth surface resistance value  $6.8 \times 10^6 \Omega$  of the surface of 3.5 micrometers of thickness was obtained.

[0095]Example 5 (conductive composition 5)

Indole- 5-carboxylic acid trimer 3 mass part, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, The stirring dissolution of gamma-glycidyloxypropyl trimethoxysilane 0.5 mass part, colloidal silica (particle diameter: 20 nm) 5 mass part, and the ammonia 1.0 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried in 50 **\*\*x** 5 minutes. The water-white film of smooth surface resistance value  $5.9 \times 10^7 \Omega$  of the surface of 3.0 micrometers of thickness was obtained.

[0096]Example 6 (conductive composition 6)



The stirring dissolution of indole- 5-sulfonic acid trimer 3 mass part, polyvinyl alcohol 1 mass part, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, and the ammonia 0.4 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried in 150 °C x 5 minutes. The water-white film of smooth surface resistance value  $3.7 \times 10^{-7} \Omega$  of the surface of 2.0 micrometers of thickness was obtained.

[0097]Example 7 (conductive composition 7)

Indole- 5-carboxylic acid trimer 1 mass part, 2, 4-tolylene diisocyanate 1 mass part, The stirring dissolution of ammonia 2 mass part, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, and the dodecylbenzenesulfonic acid 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried in 150 °C x 5 minutes. The water-white film of smooth surface resistance value  $3.9 \times 10^{-6} \Omega$  of the surface of 5.0 micrometers of thickness was obtained.

[0098]Example 8 (conductive composition 8)

Indole- 5-carboxylic acid trimer 1 mass part, gamma-glycidyloxy propylmethyl dimethoxysilane 0.5 mass part, The stirring dissolution of water-soluble-polyester resin "Arras Tarr 300" (made by Arakawa Chemical Industries, Ltd.) 4 mass part and the dodecylbenzenesulfonic acid 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied by the bar code method on the PET film, and was dried in 50 °C x 5 minutes. The water-white film of smooth surface resistance value  $6.3 \times 10^{-7} \Omega$  of the surface of 1.0 micrometer of thickness was obtained.

[0099]Example 9 (conductive composition 9)

Indole- 5-carboxylic acid trimer 0.5 mass part, gamma-glycidyloxypropyl trimethoxysilane 0.5 mass part, The stirring dissolution of ammonia 1 mass part and the water-soluble-polyester resin "Arras Tarr 300" (made by Arakawa Chemical Industries, Ltd.) 3 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried in 40 °C x 5 minutes. The water-white film of smooth surface resistance value  $2.8 \times 10^{-8} \Omega$  of the surface of 0.5 micrometer of thickness was obtained.

[0100]Example 10 (conductive composition 10)

Indole- 5-sulfonic acid trimer 3 mass part, gamma-glycidyloxypropyl trimethoxysilane 0.5 mass part, The stirring dissolution of water-soluble-polyester resin "Arras Tarr 300" (made by Arakawa Chemical Industries, Ltd.) 3 mass part and the dodecylbenzenesulfonic acid 0.5 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried in 80 °C x 5 minutes. The water-white film of smooth surface resistance value  $3.3 \times 10^{-7} \Omega$  of the surface of 3.0 micrometers of thickness was obtained.

[0101]Example 11 (conductive composition 11)

The stirring dissolution of indole- 5-carbonitrile trimer 1 mass part, polyvinyl alcohol 0.5 mass part, polyester resin (Toyobo Byron 290) 0.5 mass part, and the ammonia 0.7 mass part was carried out at the

room temperature at acetone 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the dip method on the glass substrate, and was dried in 150 °C x 5 minutes. The water-white film of smooth surface resistance value  $3.9 \times 10^{-7} \Omega$  of the surface of 1.0 micrometer of thickness was obtained.

[0102]Example 12 (conductive composition 12)

The stirring dissolution of indole-5-carbonitrile trimer 8 mass part of a dedope state and the polyvinyl alcohol 0.5 mass part was carried out at the room temperature at dimethylformamide 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 150 °C. After this glass substrate was immersed for 5 minutes into 1M sulfuric acid solution, it was made to dry in 150 °C x 5 minutes. The water-white film of smooth surface resistance value  $3.1 \times 10^{-6} \Omega$  of the surface of 2.0 micrometers of thickness was obtained.

[0103]Comparative example 1 (conductive composition 13)

The stirring dissolution of indole-5-carboxylic acid trimer 5 mass part and the ammonia 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 °C. The water-white film of smooth surface resistance value  $2.2 \times 10^{-6} \Omega$  of the surface of 3.5 micrometers of thickness was obtained.

[0104]Comparative example 2 (conductive composition 14)

The stirring dissolution of indole-5-carboxylic acid trimer 3 mass part, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, and the ammonia 1.0 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 100 °C. The water-white film of smooth surface resistance value  $1.4 \times 10^{-7} \Omega$  of the surface of 3.0 micrometers of thickness was obtained.

[0105]Comparative example 3 (conductive composition 15)

The stirring dissolution of poly aniline 1 mass part of a dedope state, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, and the perfluoro dodecylcarboxylic acid 1 mass part was carried out at the room temperature at N-methyl-2-pyrrolidone 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 150 °C. 1M sulfuric acid solution was made to immerse this glass substrate for 10 minutes, it was dried at 100 °C, and the dark blue film of smooth surface resistance value  $3.0 \times 10^{-9} \Omega$  of the surface of 1.0 micrometer of thickness was obtained.

[0106]Comparative example 4 (conductive composition 16)

The stirring dissolution of carbon black 1 mass part, acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part, and the sodium-polystyrene-sulfonate 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 °C. The black film of smooth surface resistance value  $3.0 \times 10^{-12} \Omega$  of the surface of 1.0 micrometer of thickness was obtained.

[0107]Comparative example 5 (conductive composition 17)

The stirring dissolution of sodium-polystyrene-sulfonate 1 mass part and the acrylic emulsion "diagram knurl MX-1708" (made by Mitsubishi Rayon Co., Ltd.) 20 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 \*\*. The film of smooth surface resistance value  $5.0 \times 10^{12} \Omega$  of the surface of 0.7 micrometer of thickness was obtained.

[0108]Comparative example 6 (conductive composition 18)

Poly (2-sulfo- 5-methoxy-1,4-imino phenylene) (sulfonation poly aniline) 1 mass part, The stirring dissolution of ammonia 1 mass part, water-soluble-polyester resin "Arras Tarr 300" (made by Arakawa Chemical Industries, Ltd.) 3 mass part, and the lithium-chloride 1 mass part was carried out at the room temperature at water 100 mass part, and the conductive composition was adjusted. Thus, the obtained solution was applied with the spin coat method on the glass substrate, and was dried at 80 \*\*. The yellow bright film of smooth surface resistance value  $7.5 \times 10^7 \Omega$  of the surface of 1.0 micrometer of thickness was obtained.

[0109]The following item was evaluated about the conductor created by the valuation method examples 1-12 and the comparative examples 1-6. A result is shown in Table 1.

- 2 terminal method (inter electrode distance: 20 mm) was used for measurement of a surface resistance value under the surface resistance value of 25 \*\*, and the conditions of 15%RH.

- The surface resistance value (SR0) was measured about the conductor obtained in 13 to waterproof evaluation example 24 Examples 1-12. This conductor was immersed into a 40 \*\* solvent for 1 hour, the observation of appearance and the surface resistance value (SR1) were measured, and R1/R0 was computed.

The surface resistance value (SR0) was measured about the conductor obtained by the seven to comparative example 12 comparative examples 1-6. This conductor was immersed into a 40 \*\* solvent for 1 hour, the observation of appearance and the surface resistance value (SR1) were measured, and R1/R0 was computed.

- The state of the coat was observed for appearance by viewing after 1-hour immersion in 40 \*\* of painted-surface appearance, and a solvent.

O : — with an immersion front and no change (gloss — transparent)

x : — an ingredient — elution - \*\*\*\*\* — having had — the pencil scratch test (based on JIS K5400) was carried out about the conductor.

[0110]

[Table 1]

	導電 性組 成物	表面抵抗値： SR0 ( $\Omega$ )	表面抵抗値： SR1 ( $\Omega$ )	浸漬溶媒	耐水性 SR1/SR0	外観	硬度
実施例13	1	$6.9 \times 10^8$	$7.5 \times 10^8$	DMF	1.1	○	HB
実施例14	2	$4.8 \times 10^6$	$5.0 \times 10^6$	NH <sub>3</sub> a q	1.0	○	H
実施例15	3	$4.2 \times 10^7$	$5.6 \times 10^7$	NH <sub>3</sub> a q	1.3	○	H
実施例16	4	$6.8 \times 10^6$	$7.0 \times 10^6$	NH <sub>3</sub> a q	1.0	○	5H
実施例17	5	$5.9 \times 10^7$	$6.1 \times 10^7$	NH <sub>3</sub> a q	1.0	○	5H
実施例18	6	$3.7 \times 10^7$	$3.9 \times 10^7$	NH <sub>3</sub> a q	1.1	○	HB
実施例19	7	$3.9 \times 10^6$	$7.3 \times 10^6$	NH <sub>3</sub> a q	1.9	○	HB
実施例20	8	$6.3 \times 10^7$	$6.8 \times 10^7$	NH <sub>3</sub> a q	1.1	○	H
実施例21	9	$2.8 \times 10^8$	$3.8 \times 10^8$	NH <sub>3</sub> a q	1.4	○	H
実施例22	10	$3.3 \times 10^7$	$5.0 \times 10^7$	NH <sub>3</sub> a q	1.5	○	H
実施例23	11	$3.9 \times 10^7$	$8.2 \times 10^7$	アセトン	2.1	○	HB
実施例24	12	$3.1 \times 10^6$	$9.2 \times 10^6$	DMF	3.0	○	HB
比較例7	1	$2.2 \times 10^6$	$>10^{13}$	NH <sub>3</sub> a q	$>10^7$	×	B
比較例8	2	$1.4 \times 10^7$	$>10^{13}$	NH <sub>3</sub> a q	$>10^6$	×	B
比較例9	3	$3.0 \times 10^9$	$5.0 \times 10^{12}$	DMF	$>10^3$	○	B
比較例10	4	$3.0 \times 10^{12}$	$>10^{13}$	NH <sub>3</sub> a q	$>10$	×	B
比較例11	5	$5.0 \times 10^{12}$	$>10^{13}$	NH <sub>3</sub> a q	$>10$	×	B
比較例12	6	$7.5 \times 10^7$	$>10^{13}$	NH <sub>3</sub> a q	$>10^6$	×	B

DMF：ジメチルホルムアミド

NH<sub>3</sub> a q：0.1N アンモニア水

[0111]

[Effect of the Invention]1. The conductive composition by this invention can obtain the conductive thin film which there is no humidity dependency in a suitable substrate about this constituent only at spreading, a spray, the cast, dip, and heat-treatment, revealed high conductivity, and was excellent in membrane formation nature, a moldability, water-white nature, solvent resistance, a water resisting property, hardness, and weatherability.

In this invention, an indole-derivatives trimer 2. Membrane formation nature, moldability, The transparent conductive poly membrane excellent in water-white nature, solvent resistance, a water resisting property, hardness, and weatherability, There is no humidity dependency in a suitable substrate after formation and at ordinary temperature by processing of spreading, a spray, the cast, dip, etc. only at neglect or heat-treatment, high conductivity can be revealed, and a conductor with small dispersion in surface resistance can be obtained.

[Translation done.]